REMARKS/ARGUMENTS

Reconsideration of this application is requested. Claims 18-22, 24-29 and 31-37 are in the case.

I. THE INTERVIEW

At the outset, the undersigned wishes to thank the Examiner (Mr. Shumate) for agreeing to conduct an interview in this case. The interview was held on December 16, 2010, and the courtesies extended by the Examiner were most appreciated. The substance of the interview will be clear from the Interview Summary and the comments presented below.

II. THE FORMAL REJECTION

Claims 18-22, 24-29 and 31-35 rejected under 35 U.S.C. §112, second paragraph, as allegedly indefinite in view of the term "post-processing". In response, and in line with the discussion at the interview, claim 18 has been amended to state that the resulting composite membrane is subjected to a post-processing before or after drying by heating to partly remove or reduce in volume the pore fillers residing in the pore-channels of the porous substrate. Support appears at page 9, lines 2-4 and page 16 lines 1-5. Withdrawal of the formal rejection is respectfully requested.

III. THE OBVIOUSNESS REJECTION

Claims 18-22, 24-29, and 31-35 rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Kawae *et al*. (US 6,066,592) (Kawae) in view of Blaha (US

3,353,982) as evidenced by Wells (US 3,918,927), Mundshau (US 2003/0183080) and Jung *et al.* (US 3607787A) (Jung) (it is assumed the reference to Yoshiyuki at page 7, line 5 of the Action is an error). The obviousness rejection is respectfully traversed.

As discussed during the interview, the claimed invention provides a process for the preparation of a two layer metal palladium or palladium alloy composite membrane consisting of a porous substrate support and a palladium or palladium alloy membrane. The process comprises 1) rinsing/washing and drying the porous substrate support, 2) treating the porous substrate support with a pore filler in order to decorate the pores of the support and the disfigurements of the substrate surface, 3) sensitizing and activating with a palladium solution the decorated substrate support, 4) plating the resulting support with a palladium solution to form the two layer composite membrane, 5) drying, and 6) subjecting the resulting composite membrane to a post-processing before or after drying by heating to partly remove or reduce in volume the pore fillers residing in the pore-channels of the porous substrate.

The invention provides a procedure for preventing the penetration of metal into the pores of the porous support during the deposition of the metal from electroless plating baths, where the auxiliary substances (pore fillers) are not completely removed after deposition of a metal layer, but transformed into porous substances through thermal treatment. This is achieved by preoccupying the pores of the support with the claimed modifiers prior to the deposition of the metal layer, which are transformed into a porous filler within the pores of the support by thermal treatment after the layer has been deposited. During the heat treatment, the pore filler partly decomposes and

releases gaseous products, e.g. CO, CO_2, or H_2O, which can easily escape from the porous support structure without causing damage to the deposited metal layer.

It is to be noted that these gaseous molecules are also typical components of the H_2-containing gas streams, from which the H_2 is to be separated by means of the composite Pd membrane at temperatures up to 700°C. It is an important characteristic of the present invention that the auxiliary substance at least partly stays behind in the support of the finished composite membrane and that the pore structure, the pore size, and the pore volume of the support are altered after deposition of the metal layer. In particular, the pore size of the support pores modified with the porous filler in the finished composite Pd membrane is in general smaller than the thickness of the deposited Pd layer.

The inventors have thus identified that a two-layer metal composite membrane can be fabricated in which the pore fillers are not completely removed after deposition of a metal layer, but are processed through thermal treatment such that their size within the pores of the substrate is reduced. Without being bound to any particular theory, it is thought that in examples of the claimed invention, the adhesion between the metal membrane layer and the porous support is not substantially compromised following the fabrication process of the present invention even after the partial removal or reduction in volume of the pore fillers. This is believed arise because, first, filler remains in and on the support after the thermal treatment and thus bonds formed between the deposited metal layer and the porous support surface remain intact. Secondly, during the transformation of the pore filler at elevated temperatures, bonds can be formed between the porous filler and the porous support in some examples which can strengthen the

adhesion between the deposited metal layer and the porous support and thus improve the overall stability of the composite membrane system.

Kawae does not suggest the claimed step wherein pore fillers are "partly" removed or reduced in volume through heating (step 6). In the gas separator of Kawae, a metal, for example palladium, membrane is provided for separating the gas. Kawae includes the step of filling the metal membrane material into the pores of the substrate "to close them" (Abstract). During the interview, the Examiner mentioned that Fig. 1 of Kawae appears to disclose some pores which are not closed. However, this interpretation does not fit with the discussion of Fig. 1 of Kawae, where it is stated (col. 2, lines 61-67):

> "The porous substrate 2 is porous, and so it has many pores 5, and some of the pores extend to the surface of the porous substrate 2 and they are opened thereon. In the present invention, **the metal 3 for separating the gas is filled into the pores 5 opened on a porous substrate surface 2a to close them**." (Emphasis added)

Kawae thus clearly directs that the pores are closed. The material filled in the pores of the substrate provides a function in the resulting membrane product, namely the separation of the gas.

Based on the above, there would have been no motivation based on Kawae for one of ordinary skill, as of the filing date of the present case, to carry out a treatment which would remove or reduce in volume the material in the pores. This is because the pore filler in Kawae is added to "close" the pores and to provide the function of gas separation.

The Action suggests that the skilled person would consider replacing the gas separator metal filled into the pores of the substrate of Kawae with a calcium carbonate material (referring to Blaha). Applicants respectfully disagree.

In Kawae, the pores are closed to give the membrane product its function of separating the gas. Thus, as stated in Kawae (col. 4. lines 15 to 19), in some examples of Kawae, "the metal 3 for separating the gas present in the porous substrate 2 functions to separate the gas, and hence such a gas separating film 4 as shown in Fig 1 is not essential".

Based on this, the skilled person would not have been motivated to change the process of Kawae to include anything in the pores other than the gas separating metal described in Kawae. To do so would have removed the functional gas separating component of Kawae.

Even if the skilled person had considered filling the pores of the substrate of Kawae with a material other than the metal as described (it is believed this change would not have occurred for the reasons noted above), there is nothing in Kawae which would have led the skilled person to fill the pores with calcium carbonate, and then carry out a process to partly remove or reduce in volume the pore fillers, as required by the presently claimed process. As Kawae makes clear (col. 3, lines 5 to 8): "in the gas separator 1 of the present invention, the metal 3 for separating the gas is filled into the pores 5 **to close them**, so that the material gas is prevented from leaking into a purified gas" (emphasis added). The skilled person would therefore have understood from Kawae that the pores should be "closed". There would have been no motivation to

carry out a treatment which would partly remove or reduce in volume the pore filler in the substrate.

Referring to the comment on page 9, first paragraph of the Action, contrary to this, the skilled person would not have considered replacing the metal gas separator pore filler of Kawae with calcium carbonate, because the skilled person would have realized that calcium carbonate would not be suitable to provide the features taught by Kawae to be essential of the pore filler, namely that it be a metal gas separator, and also (having reference to the passage at col. 3, lines 5 to 8 of Kawae, discussed above) will close the pores. For the same reason, the skilled person would not have been motivated to process the pore filler such that it is partly removed or reduced in volume in the substrate.

There is nothing in Blaha regarding partly removing or reducing in volume a pore filler, and no suggestion in Blaha of heating the pore filler to partly remove or reduce it in volume. As noted during the interview, Blaha discloses that the calcium carbonate is **removed** from the pores of the ceramic (typically by a leaching treatment). Thus, Blaha states (col. 2, lines 1-11):

> "After the metal film is complete, the entire structure is treated to **remove** the whiting, or other filler, from the pores of the ceramic. This can be a leaching operation.... Since both the film and the support are porous, the liquid [e.g., acetic acid] can be forced through them to **dissolve and carry away the filler**... After the filler has been **removed**, the filter is washed, sterilized and ready for use." (Emphasis added)

Blaha thus provides no suggestion of partial removal of the whiting (calcium carbonate).

In light of the above, even if the skilled person had considered including calcium carbonate of Blaha in the porous substrate of Kawae (it is believed this would not have occurred at least for the reasons given above), there is nothing in Blaha or Kawae, taken singly or in combination, which would have led the skilled person to **partially** remove or reduce in volume a pore filler by heating as required by the presently claimed invention.

The Action refers to Drost as discussing filling pores of a substrate and subsequently removing the pore filler. Drost discloses that the pore filler is **removed**, in this case being chemically dissolved. There is nothing in Drost to suggest a heat treatment on the pore filler as presently claimed and, in particular, nothing in Drost to suggest that the pore filler could be partially removed or reduced in volume as presently claimed.

Similarly, there is nothing in Mundschau or Jung to suggest a process of preparing a two layer metal composite membrane in which pores of a porous substrate are filled with a pore filler which, after forming of the composite membrane, is subsequently partially removed or reduced in volume by heating as presently claimed.

Wells is cited because of an alleged disclosure of conventional plating processes to produce a plated product having good adhesion of the metal plate thereto. Wells clearly does not cure the above-noted deficiencies of the other cited art.

Withdrawal of the obviousness rejection is respectfully requested.

Favorable action is awaited.

Respectfully submitted,

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